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"Popping" the Tool-Kit

One of our industrial correspondents seems worried about machine tool exports. He takes the view that British industry is being—as a long-term policy—severely handicapped by present events. This is what he writes.

"A disposal sale of second-hand machine tools was recently held in Coventry. Twelve hundred representatives of British industries queued up at the saleroom at midnight. They waited eight hours for the doors to open—nearly fell over one another in their efforts to book the machines they required. This is one example of the crying need of British factories for machine tools. Without them they cannot replace worn-out models or expand the production of goods everyone wants. Yet the bulk of new machine tools made in Britain is going abroad. They will re-equip competitors of British industries, whilst our own manufacturers have to join in a mad scramble for second-hand stuff."

It does, on any superficial examination, seem ridiculous to be exporting the means of production rather than finished articles, yet there is a large volume of opinion which is convinced that the industrialisation of the overseas markets will eventually result in an increase in the buying capacity of those countries. The United Kingdom should then be in a position to unload mass-produced goods, which overseas markets will never be in a position to make owing to the limited number of potential purchasers in any one of the predominantly agricultural countries. If it be granted that this argument is sound, it still does not contradict our correspondent's views, which, by implication, postulate that we require the best of modern machine tools for mass-production. If a craftsman is hard up, the last thing he pawns is his tools, and this applies equally well to a country. We should imagine that the first party of 1,000 craftsmen and labourers from the British building trades due to arrive in Australia in December, as reported in "The Times," will guard their tool kits as the most precious part of their personal belongings.

To quote our correspondent again, as he supports his argument with figures taken from the Board of Trade and from personal experience:—

"Some machine tool manufacturers in the Midlands are exporting 4 machines for every one they are allowed to supply to home manufacturers. Over 60 per cent. of the machine tools of a large Scottish firm are exported. Meantime, British firms have to wait up to 12 or 14 months for such new machine tools as they can get. Sometimes no definite date of delivery can be given. In such cases it is difficult to have a firm price. Conditions and costs change from week to week. Manufacturers do not know where they stand. Textiles, plastics, motor cars, Diesel, pottery—practically every British industry is affected. To re-equip their factories our manufacturers are buying the machine tools which served Britain during the war. Over 4,000 are bought every month. This policy of re-equipping our industries with second-hand articles, while competitors abroad get up-to-date models, is suicidal. We are sacrificing an all-round increase in production for a temporary gain in profits. The Government seem determined to boost export figures—even at the price of crippling the output of our factories for years to come. It is more important than ever that British factories should have up-to-date machines. Hours are cut. Wages are bumped up.

"The only way to counteract increased costs is to speed the rate of manufacture. That can only be

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JAMES WATT MEMORIAL

A memorial to James Watt, inventor of the steam engine (shown below), was unveiled at Kinneil Palace, Bo'ness, recently, by Mr. H. E. White, chairman of the Carron Company. In the form of a 3-ton cast-iron cylinder, the memorial was cast by the Carron Company to Watt's orders about the end of the 18th century. The cylinder is the sole remaining relic of

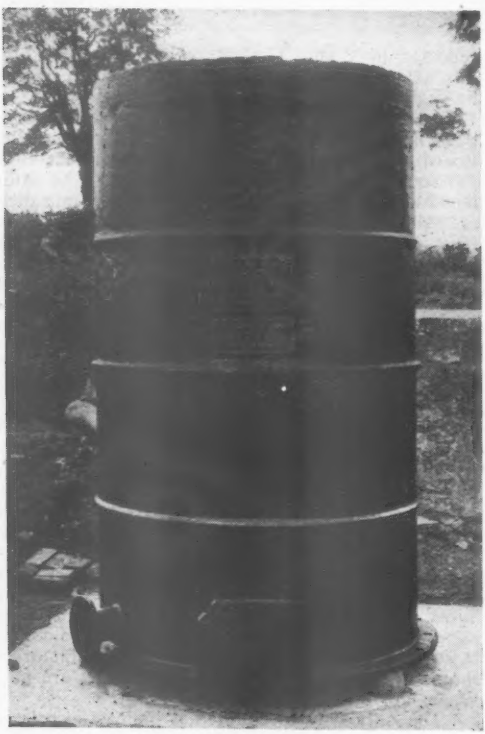


FIG. 1.

Watt's first successful steam engine, which was made to pump water from coal mines at Bo'ness belonging to Dr. John Roebuck, one of the founders of the Carron Company. In an outhouse at Kinneil Palace, Watt, under the patronage of Dr. Roebuck, conducted the experiments which resulted in the production of the steam engine and the dawn of the industrial era.

VICKERS-ARMSTRONGS, LIMITED, are to rebuild the brassfoundry at their Elswick Works, Newcastle-upon-Tyne.

NEW CATALOGUES

Liquid Metal Pump. Penicud & Company, of 3, Rue Victor, Bagnolet, Seine, France, have designed and placed on the market a pump for handling liquid metals up to 1,200 deg. C. Thus, metal can be pumped from a crucible, without the use of a ladle, directly into the mould. By the use of a pump the metal is freed from slag and scum, and is well mixed. Where ingoting is practised, an installation of water-cooled rotating moulds is suggested. The pumps are either manually or electrically operated, and are available in five sizes, capable of giving 2, 4, 6, 8 or 10 litres per piston stroke. Manual operation ends with the 4-litre model. The speed of flow is 5 secs. up to 6 litres, and 7 to 10 beyond that capacity. This and other information is given in French in a two-page illustrated leaflet just received from Paris.

Cast Die Blocks. Carrying the caption "Meehanite, the Metal for Permanent Molds," the Meehanite Metal Corporation, of 800, Pershing Square Buildings, New Rochelle, N.Y., have just published a four-page leaflet (Bulletin No. 23) which deals with the suitability of high-duty iron for castings to be used for gravity diecasting. Magna flux testing shows how ordinary cast iron quickly develops surface cracks, when so used, whilst a heat-resisting Meehanite withstands repeated reheatings for molten glass and metal quite well.

"Popping" the Tool-Kit

(*Continued from previous page.*)

done with the most modern machinery. Admittedly output of machine tools is restricted by a shortage in castings. The foundry industry is handicapped by lack of skilled labour. With such a scarcity existing, it is a matter of life or death to the country that first priority should be given to British manufacturers. Otherwise, when foreign industries get to work with our best machine tools, they will outstrip us. Our long-term permanent exports, on which we depend for our livelihood, will be cut out."

It does seem that more attention should be given to the type of export. The world is hungry for every variety of goods and facilities should be given for the export of finished machinery and manufactured goods. Machine tools must, of course, be exported. If the Nigerian railways require a lathe for their workshops; or ship-repairing yards at Montevideo, a drilling machine, they should be supplied for the sake of international traffic, for it must be remembered that many areas have, like ourselves, been without the possibility of replacements over a very long period. Old customers must be remembered, even if it does involve some sacrifice on our part. Despite everything, we must have the tools to win the peace, just as they were essential to win the war.

HOT-BLAST CUPOLA DESIGN*

By E. LONGDEN, M.I.Mech.E.‡

The Proceedings of the Institute of British Foundrymen contain an extraordinary collection of practical, technical and scientific foundry data. It could be thought that all aspects and angles of approach to the efficient production of castings had been explored and re-explored. But the long records of the Institute can be searched in vain for any substantial information on the performance of hot-blast cupolas. The paucity of information is, no doubt, due to the remarkable absence of any well-known attempt to develop this special type of cupola in Britain. It is, therefore, necessary to examine the many hot-blast cupola systems designed and evolved, principally, in Germany and the U.S.A.

When deciding to make a general survey of the best-known systems the magnitude of the task was not fully foreseen. Its incompleteness is, therefore, to be understood. These notes, however, may at least serve to direct further attention to the possibilities of developing the hot-blast cupola in this country.

The systems to be outlined in Figs. 1 to 15 include the hot-blast cupola designed by the Author† which awaits further development. It will be shown that the application of preheated air to melt cast iron in the cupola type of furnace has been successful when basic and fundamental principles have been thoroughly recognised in the light of tonnage requirements and an improved control over the quality of the metal. The most outstanding example is that of the Griffin hot-blast cupola, developed by F. K. Vial, vice-president, Griffin Wheel Company, U.S.A. A recent treatise, "The Economics of Cupola Operational Control," by Mr. Vial, is a monumental work and should be read by all who wish to understand the atmosphere of the cupola. Some of the reactions in the cupola are briefly outlined and illustrated. It seems well established that they are not one-way reactions.

General Observations

Since the cupola is the most common type of melting furnace it can be readily understood that its performance has been examined by numberless foundrymen of many nationalities. Although the cupola is the most economical melting unit its thermal efficiency is generally below 38 per cent., and its main product—cast iron—is not under precise control as in other types of furnaces. The escape of sensible and potential heat units through the stack to the outside atmosphere has arrested the attention of the thoughtful foundryman. He has been very conscious of his inability to determine, with any great degree of certainty, the quality of the cupola metal which is melted in direct contact with the fuel and products of combustion.

Many attempts have been made to increase the efficiency of the cold-blast cupola by various combinations of air input and shapes of tuyeres, design of cupola lining and height of the preheating zone. During the past two decades the most notable success has been achieved by the Poumay cupola design and, in particular, by the Fletcher balanced blast cupola developed by the British Cast Iron Research Association. In each case a high thermal efficiency is obtained and an improved control over the properties of the metal is achieved.

Good cupola practice is now more widespread due to the propagation of the simple fundamentals of combustion and the effect of the cupola atmosphere on the properties of the metal. The increased demand for higher quality cast irons has been a spur to the wider adoption of sound cupola control. It is not to be inferred by such a statement that good cupola practice is of recent origin. The excellent work of the younger technologists, such as Braidwood, was preceded by much pioneer work by R. Buchanan, Fletcher, Hurst, Pearce and Dawson.

From time to time some special modification of the cupola and its operation is announced for which high efficiencies are attributed. Such claims are, usually, not well substantiated. It may be claimed for a particular design of cupola, or for its operational aspects, that the principal object has been to: (1) Secure economy in fuel consumption by attaining the maximum thermal values in the shallowest combustion zone by burning the fuel vigorously to obtain the largest amount of carbon dioxide in that zone; (2) reduce oxidation of the metal and attain a higher fuel efficiency by repressing the production of CO_2 in favour of CO in the combustion and lower melting zone and providing for a more complete burning to CO_2 at the higher melting and preheating zones; (3) provide the maximum control to obtain the most reliable qualities of metal; (4) provide metal at the most desirable temperature; (5) obtain the lowest possible metallic losses; and (6) provide adequate volumes of metal at the right time and place.

Efficiency Factors

Satisfactory cupola control is based on a knowledge of the reactions which take place very rapidly in the various zones of the cupola. As a basis of understanding it is usual to divide the shaft of the cupola into well-defined zones. Commencing with the base of the cupola they are: (*a*) The well, or crucible, for collecting the molten iron; (*b*) tuyere or air inlet zone; (*c*) the combustion zone where oxygen combines with the incandescent carbons with a generation of heat; (*d*) the melting zone where the solid iron is converted to fluid metal; (*e*) the preheating zone where some of the sensible heat of the ascending gases is transmitted to the descending solid materials; and (*f*) the stack or chimney for the escape of effluent gas.

When combustion produces carbon dioxide three times the heat units will be generated as against carbon monoxide formation. Therefore, the maximum thermal

* A Paper read before the annual conference of the Institute of British Foundrymen, June, 1946.
†Patent No. 526,443.
‡Consulting foundry engineer.

Hot-blast Cupola Design

efficiency is measured by the ratio of CO_2 to CO gas formed in the reactions. It is considered to be good cupola practice when 50 per cent. of the carbon is burned to CO_2. The maximum thermal efficiency, however, is not necessarily to be desired since the presence of CO_2 is oxidising. The ratio of CO_2 to CO changes very rapidly and continuously in the various zones of the cupola. In the presence of incandescent carbon at high temperature CO_2 is unstable and is quickly reduced to CO with a consequent loss of heat. Therefore, CO_2 is reduced to CO mostly in the upper area of the melting zone and lower preheating zone.

According to Vial and one of his assistants, Prest, a reaction which is the reverse of that which takes place in the reducing zone operates at the lower temperature in the upper part of the preheating zone in so far that CO is changed back to CO_2. Thus $2CO = C + CO_2$.

These observations were made to show the trend for the equilibrium between CO and CO_2 and appears to indicate that the precipitation of carbon from CO with an increase in CO_2 takes place in the cooler regions near the top of the preheating zone. Tables I and II show the results of tests made by Vial and Prest. It will be noted in Table II that at 8½-ft. depth from the check point, 2 ft. down from the charging door, that CO_2 is as low as 1 per cent., having been reduced from 4.6 per cent. at 10 ft. CO increases to 10.8 per cent. at 2-ft. depth.

The results of increasing temperature on the reaction referred to earlier is indicated in Table I. In this test, the gas samples were taken at a constant point, 9 ft. 4 in. depth close to the melting zone. It will be noted that a higher percentage of carbon dioxide is present at the commencement of the blow when the temperature is not so high as at a later stage when the coke is heated to a highly incandescent state and carbon monoxide increases. Thompson and Becker state that the reverse reactions, CO to CO_2, as the gases ascend, do not take place at temperatures above 760 deg. C., and that the reactions continue down to a temperature of 220 deg. C. This reverse reaction they found to be, comparatively, slow, indicating that CO_2 can be increased by reducing the blast pressure, thereby allowing a longer contact of the gases with the cupola before being discharged, thus providing more time for the reactions to take place. Therefore, temperature and time determines the speed and extent of the reactions. It is, however, the reactions which develop sufficient heat above 1,150 deg. C. which can be made available for fusing the iron. Heat below this temperature is only available for preheating the materials in the cupola.

Prest's Cupola Observations

On examining the findings of various investigators, it will be noted that a well-conducted cold-blast cupola may operate at a thermal efficiency of about 36 per cent. The potential heat is accounted for in the following divisions:—

For melting iron, 36 per cent.; loss in incomplete combustion and excess air, 33 per cent.; loss in sensible heat in escaping gases, 16 per cent.; and loss in radiation and formation of slag, 15 per cent.

Vial excellently illustrates the distribution of heat in a cold- and hot-blast cupola of 60-in. lining dia. The available heat for melting and preheating is indicated in Charts 1 and 2. The probable distribution of the potential heat from 1 lb. of coke with varying fuel to iron ratios is shown under four parts:—

1st.—The portion of heat which is undeveloped.

2nd.—The portion of heat used for melting.

3rd.—The portion of heat used for preheating iron, coke and limestone.

4th.—The portion of heat as waste heat in effluent gases.

Charts 3 and 4 are very useful when considering the usual variations in cupola practice.

TABLE I (*from Vial and Prest*).
At Uniform Depth

Constant Depth.	Time.	CO_2 Per cent.
Blast on	6.01	0.0
9·4 ft.	6.06	9.7
,, ...	6.12	14.4
, ...	6.18	4.4
,, ...	6.26	3.4
,, ...	6.32	0.5
,, ...	6.45	1.2
,, ...	6.50	7.4
,, ...	6.52	7.4
,, ...	6.55	5.6
,, ...	7.00	Pipe clogged

TABLE II (*from Vial and Prest*).
At Various Depths.

Depth.	Time.	CO_2 Per cent.
2 ft.	7.20	10.8
2½	7.25	9.6
3	7.30	10.0
4½	7.33	8.4
5	7.36	6.8
7	7.42	1.0
8	7.46	1.6
8½	7.50	1.0
9	7.53	5.0
9½	7.57	3.8
10	8.01	4.6

Hot-blast Factors

It would appear that the benefits of applying preheated air to the cupola melting of metal should be indisputable. For it would seem to be obvious that

the highest degree of efficiency should be obtained by utilising as large a portion as possible of the potential heat units which normally escape through the stack of the furnace to the outside atmosphere to heat the air needed for the combustion of the correct amount of fuel. It is necessary to deliver the proper weight and volume of heated air through a blast delivery system which ensures the best possible distribution of air across the entire combustion zone, so that the maximum amount of heat units and the highest attainable temperature are concentrated just below a stable melting zone compatible with the lowest possible oxidising effects and metal losses.

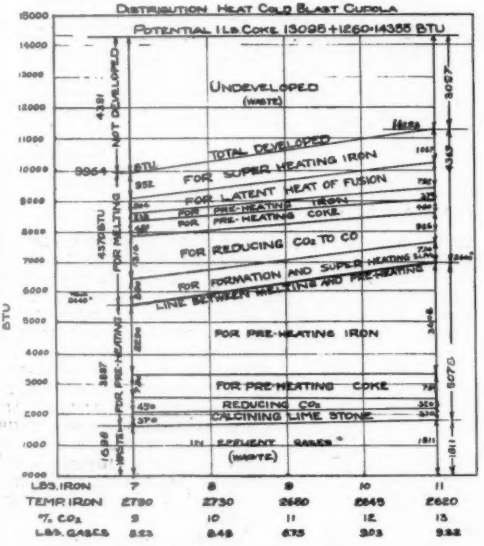


CHART 1.—AFTER F. K. VIAL.

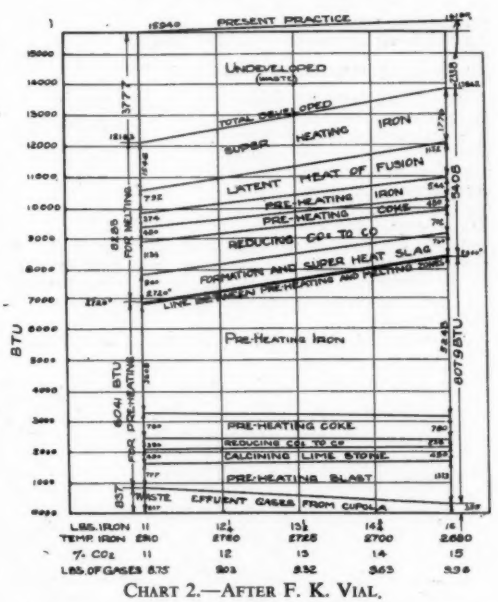


CHART 2.—AFTER F. K. VIAL.

The economics of providing preheated air for an intermittent melting furnace need to be examined. Unless the volume of metal to be melted during any day's blow is very substantial most of the best-known hot-blast cupola systems may prove uneconomical. The value of a more precise control over the quality of the metal would in many otherwise border-line cases be sufficient to declare in favour of installing a hot-blast system.

Generally, the efforts of the designers of hot-blast cupolas have been directed to utilising a portion of the potential heat units obtained from burning the incompletely-burned gases collected from certain defined zones of the cupola and, also, from the sensible heat of the gases transmitted by radiation to tubes or refractory brick passages through which, or around which, the combustion air must pass. It will, however, be shown that there are at least two departures from the methods usually employed embodied in the cupola designed by the Author shown in Fig. 11 and by the Whiting Corporation of the U.S.A. illustrated in Fig. 15.

The increased efficiency obtained by the delivery of additional B.T.U's to the combustion zone through the agency of heated air is of a higher order than would be expected from the reduction in the fuel used. This can be attributed to the greater intensity of combustion and brilliancy creating a higher temperature which favours a more rapid chemical reaction of the gases. The increased concentration of heat in the melting zone is obtained with a reduced consumption of coke and air input. The amount of slag to be melted is also reduced. In such furnaces the reduced volume of gases formed will also carry off less heat in the escaping gases. In this connection it is of interest to point out that the normal air input to a cupola is nearly equal in weight to that of the metal melted.

HOT-BLAST CUPOLA SYSTEMS

Cameron Warm-air Cupola

The simplest method of preheating the blast is conceived in the system adopted by John Cameron, a

D

Cupola Design

past-President of the Institute of British Foundrymen, and shown in Fig. 1. It will be noted that the air belt is built into the lower section of the lining. Its depth extends to cover the preheating and melting zones. Because of the intervening thin lining heat is transmitted to the air circling it before passing through the tuyeres, thus warming the air for combustion. Mr. Cameron reports that the results justified the adoption of the lining wind belt air heater.

Schuerrmann Hot-blast Cupola

Fig. 2 illustrates the Schuerrmann (German) hot-blast cupola. It is designed on the regenerator principle. The air for combustion first enters through the reversing valve, A, passes through the chamber, B, of the preheater enters the cupola at C and into combustion with the carbon of the coke. A portion of the gases of combustion now pass through to the chamber, E, thereby heating it, then through the reversing valve, A, and the throttle valve, F, to the outlet chimney, G.

A portion of the blast is by-passed to flow through two tuyeres, D, to further a more complete burning of the incompletely-burned gases passing from the cupola into the intermediate chamber, M, then on through the preheater area, E. The valve, A, is reversed at about 8-min. intervals, thus allowing the chamber to be heated. The tuyere area is much greater than in normal cupola practice. The illustration indicates that tuyeres are arranged in two rows forming two opposing groups. The gases of combustion pass partly through the tuyeres immediately opposite the air tuyeres which may be functioning and partly through to the stack of the cupola.

The efficiencies claimed are: Coke consumption of 7 to 9 per cent.; effluent gas temperature leaving the stack of the cupola, 100 to 150 deg. C., is given to prove that the brickwork of the heating chambers was absorbing a large percentage of the heat of the gases; gases leaving the stack contain about 18 per cent. CO_2 and 5 per cent. CO; reversals prevent slagging of tuyeres; and sulphur reduced by 30 per cent.

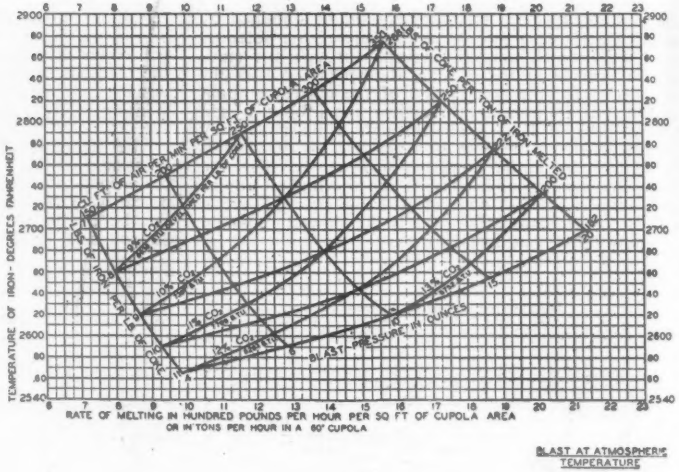

TEMPERATURE OF IRON - DEGREES FAHRENHEIT
RATE OF MELTING IN HUNDRED POUNDS PER HOUR PER SQ FT OF CUPOLA AREA
OR IN TONS PER HOUR IN A 60" CUPOLA
BLAST AT ATMOSPHERIC TEMPERATURE

CHART 3.—AFTER F. K. VIAL.

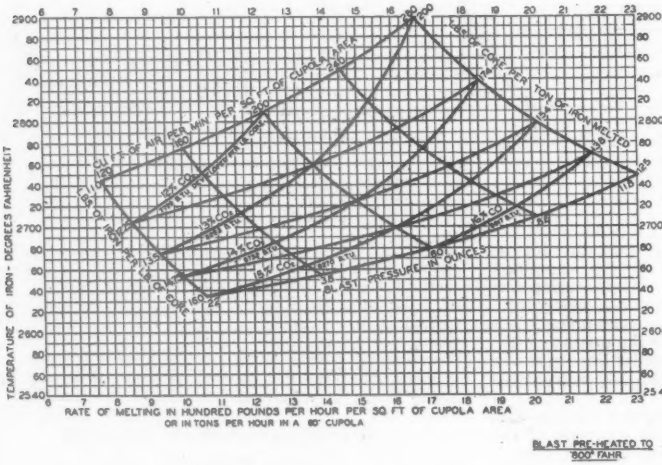

TEMPERATURE OF IRON - DEGREES FAHRENHEIT
RATE OF MELTING IN HUNDRED POUNDS PER HOUR PER SQ FT OF CUPOLA AREA
OR IN TONS PER HOUR IN A 60" CUPOLA
BLAST PRE-HEATED TO 800° FAHR

CHART 4.—AFTER F. K. VIAL.

The Frauenknecht Hot-blast Cupola

The Frauenknecht (German) system is illustrated by the

general arrangement sketch Fig. 3 and Fig. 4, which shows the arrangement of the heater pipes. The designer of this cupola describes the system as follows: If a cupola works inefficiently, losses of iron occur due to excessive oxidation. The iron may be oxidised to its oxide in the form of gas, or to iron oxide as a component of the slag. In order to obtain improved melting conditions only reducing gases must rise in the cupola.

By means of the installation of an air heater according to the Frauenknecht system, it is claimed that an

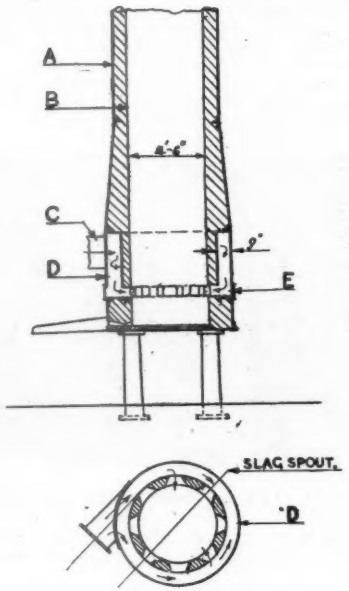


FIG. 1.—CAMERON HOT-BLAST CUPOLA.

A, cupola shell; B, brick lining face; C, cold air blast pipe from blower; D, air belt surrounding combustion and melting zone; E, tuyeres.

improved melting machine has been devised. Hot gases of combustion are led off in just above the melting zone through outlets in the lining of the cupola into vertical cast-iron ducts. After giving up heat to the vertical pipes the gases pass again into the cupola at a point above the preheating zone proper. The air required for combustion enters a blast belt just below the charging door. From this belt pipes which jacket the hot-gas ducts are suspended, the lower ends entering a second blast belt from which air passes to the tuyeres and into the combustion zone of the cupola. It appears that the principal advantages of the system are that iron losses are cut to one half of normal and a higher quality metal is obtained.

The Zoller Hot-blast Cupola

About 1938, Zoller (German) put forward a new melting process which is, in its final aspects, a hot-blast cupola. The sketches X, Y and Z in Fig. 5 illustrate the furnace design. The most unusual feature of the Zoller cupola is that there is only one charge of metal present in the cupola throughout the melting period. This single charge of metal is, however, much

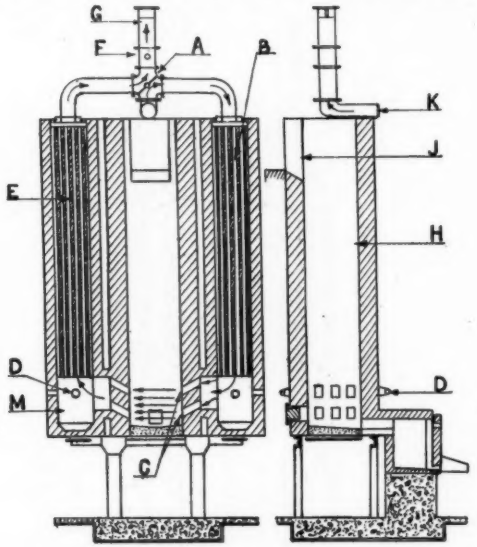


FIG. 2.—SCHUERRMANN HOT-BLAST CUPOLA.

H, cupola shaft; J, charging door; K, cold air from blower; A, reversing valve; B, pre-heater; E, pre-heater; C, main tuyeres; D, small secondary air boosting tuyeres to the chamber, M; M, distributing and secondary combustion chamber; F, throttle valve; G, outlet chimney.

larger and heavier than with standard cupola practice. The cold metal charge is placed on a coke bed which has been previously combusted to a high incandescent temperature. A covering charge of coke is then placed above the metal charge.

If it is as stated, then surely this favours a tremendous waste of heat, especially during the preliminary boosting of the coke bed to a high temperature. Zoller explains that a special arrangement utilises the escaping heat. In favourable cases, he states, the loss of heat is no greater than in normal melting practice where heat is lost due to the reactions which take place in the cupola.

Hot-blast Cupola Design

The sketch X (Fig. 5) shows at K the provision of so-termed "reflection leaves" located above the charging door, B, thus radiation returns a portion of the escaping heat units to melt and increase the temperature of the metallic charge. At the same time gases have a free exit.

Fig. 5 illustrates at sketches Y and Z a modified reflector in the general formation of the cupola just above the charging door, B, and the more important

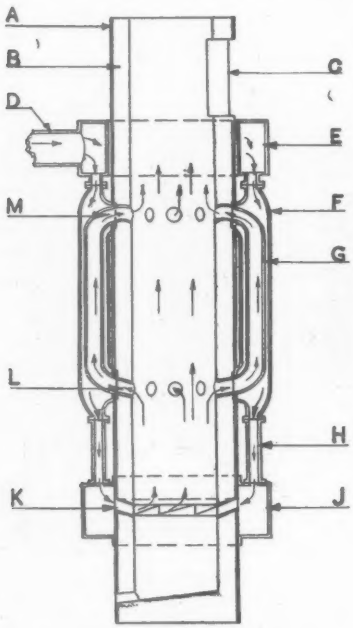


FIG. 3.—FRAUENKNECHT HOT-BLAST CUPOLA.

A, cupola shell; B, brick lining; C, charging door; D, cold blast main from blower; E cold air belt; F, air heating vertical down-tubes; G, hot gas tubes; H, heated air lead pipes; J, heated air belt; K, tuyeres for heated combustion air; L, outlet tuyeres for hot gases; M, inlet tuyeres for cooled gases.

additions of blast heaters in the stack of the cupola. It will be noted that the heaters are so designed to take up a large portion of the area in the chimney part of the cupola. Cold air from the blower enters through the blast pipe, C, then through the heater pipes, D, the air then passes through the down-lead pipes, E, wind belt, F, and into the combustion zone of the cupola through tuyeres, G.

The following advantages claimed are:—

(1) Escaping heat units are utilised to preheat the air for combustion.

(2) Minimum metallurgical changes because the metal is melted very rapidly. Sulphur pick-up is much reduced. Higher sulphur-content fuel may be used.

(3) Since there is a constant and uniform supply of coke in the furnace the fuel can be combusted with a balanced amount of air without too much excess. Thus burning reaches its highest value of CO_2.

(4) Gases of combustion do not come into contact with further metal and coke. Thereby, metal is little affected further, and the carbon dioxide cannot be dissolved back to carbon monoxide.

(5) Because the metal charges are melted separately it is possible to interrupt or delay the melting process. Differing qualities of metal can be safely dealt with.

(6) Entire process is under good control.

FIG. 4.—HEATER PIPES. (FRAUENKNECHT).

(7) One layer of coke carries only one layer of metal. Thus coke of inferior quality or strength can be used.

Anonymous German Hot-blast Duplex System

A cupola furnace design combining the cupola and air furnace hearth has been developed. On melting in the cupola shaft the metal flows into the lower hearth part of the dual furnace, where the metal is further superheated by introducing and burning pulverised fuel, gas or oil. The gases generated in the hearth can be employed to preheat the blast or increase the melting temperature in the cupola into which they pass.

Fig. 6 shows a German cupola designed to preheat the blast by withdrawing heated gases from what is termed the dead zone below the tuyeres. (The Author cannot agree that this zone is dead if gases are withdrawn, since such withdrawal will encourage the passage of air to create an extended combustion zone below the tuyeres.)

It will be noted that outlets, F, allow a passage of the gases of combustion from below the tuyeres, E, into the internal hot gas belt, G, thence through the outlet vent, M, to a point well up in the stack of the cupola. Cold air enters the wind belt, J, from the blast main, C. The air is influenced to circulate and impinge on the internal heater belt, G, by the deflector ring, K. The flow of the air is indicated by the direction arrows. Performance data are not available.

Olivo Hot-blast Cupola

The Olivo (Italian) air preheating system endeavours to utilise the hot gases escaping from the slag hole to heat the air for combustion. There is little clear information available as to the actual construction of the cupola, but the sketch (Fig. 7) will serve to explain the design. Gases flowing out of the slag hole, G, pass into the slag trough, H, above which is located a hood, J, through the vertical gas leads, L, into the heaters, F. The passage of the gases is induced by an exhauster at some convenient point of the cupola system. Cold air passes into the belts, K, where it is warmed by contact with the heaters, F, then into the air belts, D, and through the tuyeres on the centres, E.E. Apart from the general claims of the designer no data are put forward in support of this system. Indeed, the designer admits that much more tuning up of the cupola is needed.

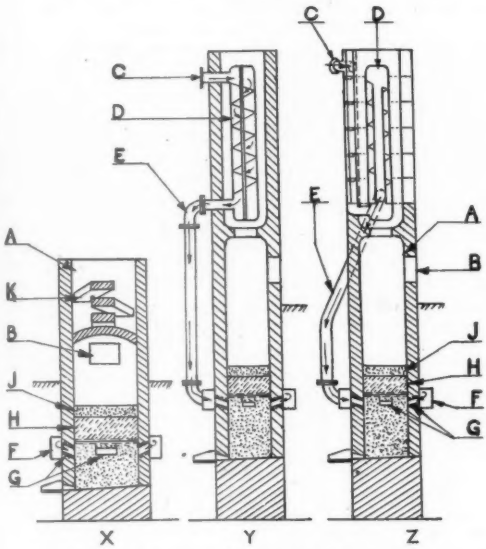


FIG. 5.—ZOLLER HOT-BLAST CUPOLA.

A, cupola shaft; B, charging door; C, cold air supply pipe; D, preheater; E, down-pipe sections for preheated air; F, air belt; G, tuyeres; H, metallic charge; J, covering coke; K, reflecting leaves.

Moore Hot-blast Cupola

The Moore hot-blast cupola system publicised by Mackenzie, the well-known American metallurgist, is illustrated in Fig. 8. The particulars given relate to a cupola of 72 in. lining dia. It will be noted that the air for combustion is heated by passing it through a series of cast-iron pipes, forming the lining of the preheating zone of the cupola. Air for combustion first enters the wind belt, I, passes upwards through the lead-pipe, 2, to the cast-iron 1¼-in. section heater pipes, 3, through the down-lead pipes, 4, to the balancing area belt, 5, then to the down-lead pipes, 6, and tuyeres, 7, into the combustion zone of the cupola. The success of the cupola in due course, after very careful trials and modifications, is proved by the conversion of a further number of cupolas to the system at the works of the American Cast-Iron Pipe Company. These cupolas have been in operation since about 1927.

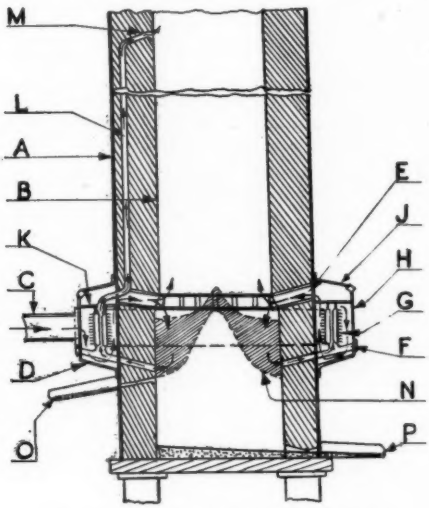


FIG. 6.—GERMAN HOT-BLAST CUPOLA.

A, cupola shell; B, inside lining face; C, cold air blast pipe; D, air belt; E, tuyeres for warmed air; F, outlet holes for preheating gases; G, internal preheater belt; H, preheating chamber; J, warmed-air section to feed the tuyeres, E; K, deflector and dividing plate; L, exhaust gas outlet, lead; M, exhaust gas inlet to cupola shaft; N, zone affected by withdrawal of gas from below tuyeres; O, slag spout; P, tapping spout.

Dr. Mackenzie has furnished the Author with recent check tests carried out in which a comparison is made between the hot-blast and cold-blast cupola. These tests are very full, and data are supplied of

Hot-blast Cupola Design

all the operational details, which would justify publication in full on some future occasion. Briefly the outstanding points are:—It was found necessary to replace the hot-blast equipment in cupola No. 5. Until the new equipment could be made it was decided to operate the cupola on cold blast in order to obtain further additional information on hot blast versus cold-blast operation. On opening up the cupola on cold blast, the first four heats were carefully checked. Accurate data were kept on all materials charged into the cupola and the metal melted. At the same time similar information was taken on the hot-blast units. A study of the data sheets reveals the following information:—

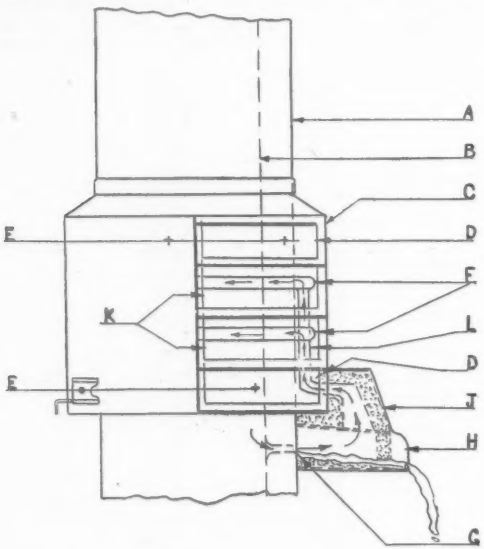


FIG. 7.—OLIVO HOT-BLAST CUPOLA.

A, cupola shell; B, inside lining face; C, air belts; D, heated air section to feed tuyeres; E, centre line of tuyeres; F, preheater chambers; G, slag hole; H, slag spout; J, slag spout hood; K, air preheating belts.

TABLE D.—*Strength Data.*
Cold Blast—3 Heats.

	Analysis.		Rockwell "B."	2 in. × 1 in. Test Bar.	
	Si	T.C.		Break Load in lbs.	Deflection in ins.
Maximum	1.26	3.62	96	2,980	0.45
Minimum	0.90	3.06	89	2,545	0.36
Average	1.08	3.38	93	2,775	0.39
Hot Blasts—3 Heats.					
Maximum	1.32	3.60	95	2,870	0.45
Minimum	1.06	3.10	86	2,515	0.34
Average	1.20	3.40	91	2,740	0.40

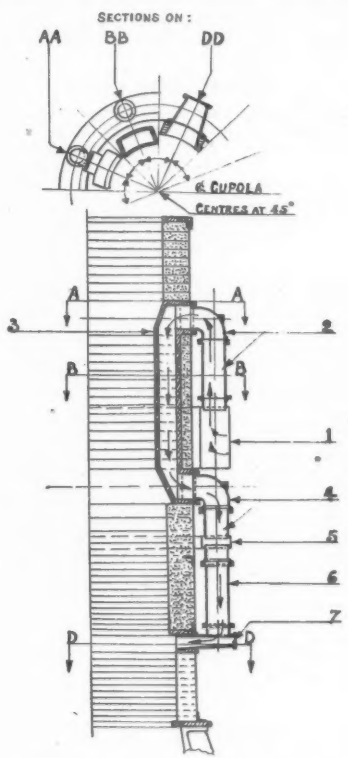


FIG. 8.—MOORE HOT-BLAST CUPOLA—VERTICAL PART CROSS-SECTION OF CUPOLA.

1, bustle pipe which receives cold air from the blower; 2, vertical riser and elbow pipe; 3, series of cast-iron pipes, 1½ in. section surrounding and forming a hollow cast-iron lining in the preheating zone; 4, elbow and lead pipe; 5, distributor pipe encircling cupola; 6, lead tube; 7, tuyere.

(*a*) The iron charged into the cupolas during this study averaged 280 tons per 9-hr. shift for the cold blast, and 266 tons for two 9-hr. and one 8-hr. shifts in the hot blast.

(*b*) The cold blast required 14.50 per cent. more blast to melt 2.15 per cent. more iron in the same length of time.

(*c*) The silicon loss averaged 2.00 per cent. more in the cold blast, or two points up.

(*d*) The average iron loss (wasted loss and charged to iron) per heat was 3,096 lb. for the cold blast and 2,474 lb. for the hot blast. This represents 1.9 lb. per ton greater loss for the cold blast.

(*e*) The cold blast required 38 lb. more pitch coke and 11 lb. less regular coke per ton.

(*f*) The refractory consumption was 0.54, 9 in. equivalents more in the cold blast.

(*g*) The iron temperature averaged 1,400 deg. C. for the cold-blast heats and 1,435 deg. C. for the hot-blast heats, a difference of 35 deg. C. in favour of the hot-blast operation.

(*h*) Another factor to be considered is the life of the cupola blocks used in lining the cupolas. A conservative estimate is that in the hot-blast cupola the lining life is at least twice that in a cold-blast cupola.

Performance data are in Table D.

(*To be continued.*)

NOTES FROM THE BRANCHES

SOUTH AFRICAN BRANCH.—Cape Town Section.—The last meeting to be reported was addressed by Mr. W. A. MacLaren on the subject of "Foundry Mechanisation." The author, well realising local conditions, ruled out machinery to be associated with heavy mass production, and rightly concentrated on the need for a range of moulding machines, and the auxiliary needed for their efficient operation. The discussion which followed kept the subject down to the jobbing shop level.

SOUTH AFRICAN BRANCH.—The March meeting, held under the presidency of Mr. H. Holdsworth, was devoted to the reading of a very practical Paper by Mr. H. A. Godwin on the subject of "Electric-arc Steelmaking." The author confined his remarks to the basic process carried out in a Héroult furnace. The material presented consisted largely of a description of a typical charge of plain carbon steel carried out in an 8-ton furnace, together with some notes on the remelting of manganese-steel scrap. The discussion ranged over steelmaking for castings, and included the Tropenas process. Herein, the author made the surprising statement that "side-blown Bessemer steel was suitable for ingots, but was not altogether suitable for the production of castings." No agreement was forthcoming as to the relative costs of production, the president maintaining that the electric process was the cheaper, and the lecturer, the Tropenas. As no actual figures were given, the audience were left to draw their own conclusions. A similar situation arose as to whether liquid acid or basic steel exhibited better life. The thanks of the members to the author were expressed by Mr. J. Tonge (past-president).

THE PRODUCTION OF "GRAND SLAM" BOMB CASTINGS

(*Continued from page* 399.)

No Trouble with Feeding

MR. J. T. WELLS suggested that at the top of the whirlgate head there would probably be a certain amount of wash, and he wondered whether that was sufficient to pierce the skin.

MR. GRAY replied that they had used an atmospheric core to start with, but it was not really necessary. There had been no trouble with the feeding with that head; but they did get into trouble with a very much thicker section which was required for an armour-piercing type design of the bomb, and when there was no room in the box to provide a proper head. The section referred to in the Paper was 8 in. long from the base of the chamber to the point of the nose, and it did quite well.

MR. E. J. CRAWLEY asked why chamotte was used for making the core, for it occurred to him that sand might have done the job; he also asked whether a core was made in sand at the beginning. The only two reasons he could think of for using chamotte were that they required a certain volume stability in the moulding material and they required a dense moulding material; perhaps they could not achieve the required density with sand.

MR. GRAY said he supposed the real reason for using chamotte was that heavy moulding of the kind described was always done with chamotte in the foundry described. The higher clay content of chamotte was of advantage, and the coarse grain even of the second layer gave a better key. He believed much of the success achieved was due to the excellent keying obtained with the chamotte on loam, but had little doubt that sand would have been satisfactory.

Vote of Thanks

THE CHAIRMAN, after inviting further contributions in writing, said the members of the Institute were glad to have such a Paper on moulding problems for publication in the Proceedings.

He proposed a most cordial vote of thanks to Mr. Gray, which was carried with enthusiasm.

MR. GRAY, in his response, expressed appreciation of the kind reception accorded him and said he would like to see many more members who were concerned with steel contributing their moulding experiences to the Institute.

TRADE MISSION TO CHINA

A British trade mission to China in the early autumn will be lead by Sir Leslie Boyce, chairman and managing director of the Gloucester Railway Carriage & Wagon Company, Limited, chairman of Wagon Repairs, Limited, and a director of the Gloucester Foundry, Limited, and other companies. He will also be responsible for transport questions. Other members will include Mr. D. Maxwell Buist (heavy electrical industries) and Mr. A. H. Carmichael (light engineering).

PATENTS AND DESIGNS ACT

By F. J. TEBBUTT

Ordinarily, the life of a Patent is 16 years, but extensions can be obtained through the High Court; but until the Patents and Designs Act, 1946, recently passed, this procedure was expensive (even in unopposed cases costs usually run up to £200). Two methods are available, (*a*) by petition, or "originating summons"—(*b*) (an originating summons is really where a court judgment is required, the matter, however, being non-contentious). Method (*b*) (commonly known as the "war losses" rule), however, only applies where the patentee, as such, has suffered loss or damage (including loss of opportunity in dealing in or developing his invention) owing to Britain being at war. To have effect, applications ordinarily must be made at least six months before the expiration date, although the court may accept applications if in before the actual expiration date. If the case comes under the "war losses" rule (*b*), as above, an application may be in order even if made after the actual expiration date, provided the court is satisfied that the delay in making application has been through the patentee having been on active service or through other circumstances arising from the war.

Procedure for Extensions Simplified

This new 1946 Act (following a report by a committee appointed by the Coalition Government) simplifies the procedure for extensions and makes applications less expensive and easier. The position now is that, while the ordinary methods can be used, if the case comes under the "war losses" rule, a person so qualifying has the option of just applying to the Comptroller of Patents for an extension, and the case can be decided if that authority thinks fit, without any actual appearance before the Comptroller. If there is a point of law in the case, the Comptroller can refer the case to the court. Appeals to the Appeals Tribunal (constituted under the Principal Act) can be made from any determination of the Comptroller. If a country belongs to the International Union for the Protection of Industrial Property and subscribes to the Convention of that body, protection for an invention (applies also to designs and trade marks) obtained in one country can be similarly obtained in any other Convention country. But notwithstanding this, this Act now gives power to the Comptroller to refuse any such protection to anything invented in Germany or Japan (or in territory occupied by the enemy) by a German or Japanese national or company between September 3, 1938 (to include occupation of Austria) and December 31, 1945.

When an application for a Patent is being examined (applies to designs also), priority to protection is there, but so as to give opportunity for objections to be made and to see whether the invention covers the requirement of being "any manner of new manufacture," particulars of the invention are published and are open to public inspection. But if an application is abandoned, there is no publication of details ordinarily. By this new Act, however, if any wartime application, subsequently abandoned, is considered by the Comptroller as having come from a German or Japanese national (or company), publication will apply, and the application and specifications with drawing samples, representations, etc., specimens, if any, are open to public inspection; thus the information is open to industry generally.

Where consequent upon an arrangement between different governments (*e.g.*, U.K. and U.S.A.), information concerning an invention has been divulged before an application for a Patent has been made, any application subsequently is to have priority over any other application, and if a Patent has been granted through information wrongly obtained through the arrangement, that Patent can be revoked and the rightful inventor given priority.

PUBLICATION RECEIVED

"Winget Life." The summer number of the house organ of Winget, Limited, Rochester. Price 3d.

If this is a representative issue it is neither fish, flesh, fowl, nor good red herring. It carries a nice article about Dame Sybil Thorndyke; exposes Mr. George Dixon's views on the conduct and policy of the engineering department; takes up space with dull caricatures of anonymous individuals; reports the meetings of groups of the joint production advisory council; prints a "pep" letter from Mr. J. C. Little; a report by Mr. Marriott on a business trip to France, and a few notes on sport. To the reviewer's mind, the publication is too much diluted with extraneous matter of a type best handled by the specialist Press.

LINSEED OIL SHORTAGE

An announcement from the Fordath Engineering Company, Limited, of West Bromwich, who are probably the largest makers of core oil in the country, reinforces what we have already stated editorially as to the serious consequences resulting from any prolonged continuation of the linseed oil shortage. The company state that they are also making representations at the highest levels to ameliorate the position. In the interim, their policy is to maintain their fixed standards of quality for their range of Glyco compounds throughout the emergency period, and they will not introduce compounds of an inferior character, which are being advocated in an effort to tide over a difficult situation.

FUEL AND THE FUTURE

The Minister of Fuel and Power is to open a three-day conference scheduled to take place from October 8 to 10 at the Kingsway Hall, in London. Mr. Frank Hudson and Mr. G. L. Harbach are to present a Paper based on work they have done for the technical committee of the Association of Bronze and Brass Founders. Further details will be published later.

THE PRODUCTION OF "GRAND SLAM" BOMB CASTINGS

Discussion of 1946 exchange Paper to the A.F.A.

The following is the discussion on "The Production of 'Grand Slam' Bomb Castings," by Mr. Basil Gray. This Paper, read and discussed at the Birmingham Conference of the Institute of British Foundrymen, was also the 1946 *exchange Paper to the American Foundrymen's Association. The Paper was printed in the August* 8 *issue of the* JOURNAL.

DISCUSSION

MR. J. T. WELLS, who was particularly interested to note the Author's comments regarding the anchoring of the core to its barrel, said that his undertaking had made bombs on a considerably smaller scale during the war and had had considerable trouble at first with the core during the casting operation. By calculation it was found that there was approximately a 15-cwt. force lifting the core while it was still floating in the steel during casting.

With regard to the protection of the nose pin, it was found that ordinary asbestos tape wrapped around the pin, with a good coating of paint, resulted in fairly easy withdrawal.

Finally, he asked for an indication of the reasons for the adoption of the particular analysis of steel used.

MR. GRAY replied that the analysis of steel used possessed many merits as compared with the nickel-chrome steel. Of course, they should have used water-hardening steel to save alloys, but unfortunately they had not a tank which was convenient for holding water, and they had to use oil. The 3 per cent. chromium steel gave the best results of any, he believed, for such items as tank armour, and even in the heavy section in which the tests were made, the specimens taken out at the base of the head had given satisfactory and uniform results. On the whole, the steel used was easier to deal with than was the nickel-chrome steel.

Gas Content of Core

MR. A. AUGSTEIN asked for information concerning the gas content of the core.

MR. GRAY replied that that was not checked, but he believed it was very low. When using the chamotte moulding compound it was desirable to heat to about 400 deg. C.—very much higher than with the ordinary sand mixture—to get some of the combined water out of the mixture. Of course, as the casting was constructed there was a hollow and almost enclosed chamber between the barrel and the sand, and one experienced a good deal of anxiety in the earlier castings lest there should be an explosion of gas, but in practice no trouble was experienced from that cause alone. There was some trouble with "blows" when the core slipped up the barrel, as mentioned in the Paper, but that was not due to gas only.

MR. C. H. KAIN (past-president, London branch) said one could imagine that Mr. Gray's Paper might very well have been written to illustrate Sir Claude Gibb's plea, made on the previous day, for craftsmen in the industry. It was a remarkable coincidence that Sir Claude should have enlarged on that subject and that Mr. Gray had presented a Paper describing a very fine feat of foundry craftsmanship.

The temperature figures given in the Paper also served to illustrate Sir Claude Gibb's statement that the metallurgical side of the foundry was much in advance of the practical side, in that the heat treatment was referred to in degrees Centigrade, whereas the core drying, and so forth, was mentioned in the rather prehistoric Fahrenheit scale. Perhaps, however, that was done for the sake of the American presentation, the Paper being an exchange Paper to the American Foundrymen's Association.

As the Paper was written for general consumption, Mr. Kain invited the Author to enlarge his references to the "compo" that was used. Many foundrymen were not familiar with the details of the "compo," and would like to hear more about the actual composition or making-up of the material used for the core. Further, he asked why Mr. Gray had used "compo" for the core and sand for the mould; inasmuch as the mould was described as a sand mould, it would seem logical to make the core in sand also.

Finally, Mr. Kain congratulated Mr. Gray and his company on a particularly fine example of foundry craftsmanship.

Composition of "Compo"

MR. GRAY said Mr. Kain was right in supposing that the temperatures relating to heat-treatment had been converted into degrees Fahrenheit for the benefit of the Americans; that this was not done for the core-drying was an oversight which had been corrected before the Paper was given, as Centigrade was used, even in the core shop.

"Compo" was made originally entirely from old crucible pots and was employed for the first heavy steel castings that were ever made. Crucible pots were scarce now and they used a high quality of calcined grog such as was used to produce the best quality fire bricks. It was used in various ways and in the present instance the ½-in. facing was pure chamotte with a clay binding having the following grading:—

Remaining on B.S.I. Sieve No.	Per cent.
16	0.5
22	1.0
30	6.0
44	7.0
60	14.0
72	10.0
85	4.0
100	5.0
150	10.0
Through 150	1.5
Coarse silt (0.05 to 0.1 mm.)	15.0
Fine silt (0.01 to 0.05 mm.)	10.5
Clay grade (under 0.01 mm.)	15.5
	100.0

"Grand Slam" Bomb Castings

This was in a pasty state, of a consistency suitable for sweeping up with the strickle. The final coat of paint consists of alundum fines and was to the following grading and mixture:—

Grading		*Mixture*
Above 0.1 mm.	4 per cent.	112 lb. alundum fines
Between 0.05 and 0.01 mm.	52 ,,	20 lb. ball clay
Between 0.01 and 0.05 mm.	37 ,,	2½ lb. dextrine
Under 0.01 mm.	7 ,,	—

For the ordinary mould for heavy castings a compo consisting of a mixture of 20 per cent. crushed grog and the remainder 60 per cent. old used fire bricks of the high alumina type and 12 per cent. clay are milled in an edge runner mill, with a water content of 8 to 11 per cent. The facing of the mould lined with this material was carried out in much the same way as for the cores described above, except that the chamotte coating was used in a more diluted state in the form of a cream. This chamotte was very satisfactory for heavy moulds but required a special technique for ramming up, and moulders in this country with the necessary experience were now few in number.

The Germans used a compo of this type but during the war the chamotte was omitted for most purposes, and crushed fire bricks only were used. In spite of that they produced heavy castings with an excellent finish owing to the excellence of their labour in this class of work.

Semi-permanent Moulds

MR. R. D. LAWRIE, congratulating Mr. Gray and his colleagues on having achieved such very fine results, said he wished he had been given the opportunity himself to have engaged in the making of the job described. Our American friends would probably have adopted the orthodox methods, but he would have gone for the unorthodox, as had Mr. Gray and his colleagues; there was always a great deal of satisfaction derived from going off the beaten track.

He felt that he would have tried to adopt something on the lines of the semi-permanent type of core and mould. He might have tried to split up the mould vertically, so that it could be used over and over again merely by re-facing. With regard to cores, he had in mind the cylinders used in the textile industry. In Lancashire they strickled them on collapsible barrels, which were merely segmented core bars, there being four, six or eight segments built around a spider. They merely coated about 2 in. of loam on the collapsible barrel, and then, immediately the casting had solidified, knocked out the wedge or key portion and the internal portions collapsed and were withdrawn complete. That might have been quicker than the method of building up which was described in the Paper. The latter method was efficient, as the results had shown, but he asked for Mr. Gray's views on the semi-permanent type of equipment.

Finally, he expressed appreciation of the Paper, which was very clear and concise.

MR. GRAY replied that he had not considered the use of permanent moulds for the work described in the Paper, and for the core at any rate he doubted that such methods were practicable; the middle was so much greater in diameter than the space through which it had to pass that any core was bound to be broken when pulled out. The barrel was pulled out after half-an-hour, and in so doing they broke the iron grids, which were wasted.

Something might have been done in the way of devising a semi-permanent mould and splitting it up, longitudinally. Given a good deal of study and care, it might have been possible. The ordinary split moulding box would be some 16 ft. long, and the operation would be difficult.

MR. LAWRIE recalled having presented a Paper some years ago, in which he had mentioned a mould 36 ft. long, split up by the methods he had suggested.

Collapsible Core Bars

MR. LAWRIE said he had adopted such methods during the last 20 years with success. He agreed that, in the case of the collapsible core bar, it should be fashioned so that it was capable of being withdrawn at the large end. In making his suggestion he had in mind also the question of contraction, and the use of a certain amount of easily compressible material at the ends.

MR. G. W. BROWN asked if Mr. Gray had considered the hydraulic method of cleaning the castings, which seemed to be eminently suited to the castings discussed in the Paper.

Again, the American methods of making the moulds seemed to lend themselves very much to the use of the Sandslinger.

Finally, recalling Mr. Gray's reference to the use of chills, he asked the perennial question, when was a chill a densener and when was a densener a chill.

MR. GRAY replied that the hydraulic cleaning method could most suitably have been applied, and the only reason they did not use it was that they had not the apparatus available. Undoubtedly the Hydroblast would have served magnificently.

MR. BROWN asked if the Americans had used it.

MR. GRAY did not think the foundry concerned—the Scullin foundry—had the apparatus available.

The American founders did not use the Sandslinger for the bomb castings because it was already occupied on another job. They were ramming up 20-ton ship stern frame castings with a Sandslinger, ramming four moulds a day with one Sandslinger and producing almost by mass-production methods.

Denseners and Chills

With regard to the question concerning denseners and chills, his interpretation was that a densener was used inside a casting, as a sort of internal chill; it was also called a chill when used inside, but he believed it should then be called a densener.

The CHAIRMAN (Mr. J. W. Gardom) said he felt that Mr. Brown had in mind the effect rather than the position of the densener or chill.

MR. BROWN agreed and said there seemed to be no definite line of demarcation. He had made ploughshares in the past, and the chills were used for the purpose of chilling the metal.

MR. GRAY said they did not chill permanently in steel.

MR. R. D. LAWRIE, speaking from the cast iron point of view, said the purpose of a chill was to give a chilled white structure, whereas the purpose of a densener was to equalise the rate of cooling and produce a homogeneous structure. So that a densener was a densener, whether it was applied inside or outside; and the same applied to a chill. There was a definite line of demarcation. A chill produced a chilled structure in cast iron, whereas a densener did not.

MR. GRAY commented that Mr. Lawrie was probably right from the iron standpoint, but he believed his steel friends did not use the word "chill" in the same way.

MR. BROWN suggested that the malleable iron makers used denseners as denseners more than did other branches of the industry.

MR. GRAY, referring to the production of some steel castings he had seen in America, said he had never before known so many chills to be used inside; they were studded with nails and lumps of steel.

Drying of Chamotte Moulds

MR. J. DAVENPORT, referring to the drying of the chamotte moulds, where the moisture percentage was higher than was the case in ordinary dry sand moulding practice, asked what was the drying time when the hot air driers were used.

Recalling the reference in the Paper to the high degree of accuracy required in the patterns and to the indifferent timber that was available, he said it seemed that the outside form of the bomb lent itself to the use of some simple cast iron pattern. He asked if Mr. Gray and his colleagues had used simple cast iron or other metal patterns, because in his experience the use of chamotte had a very bad effect on wooden patterns, far worse than the effect of sand.

MR. GRAY replied that the drying time for the chamotte moulds, when using the hot air driers, was about six hours; and the portable ones they had rigged up were far more effective than the ordinary drier. There was only a limited capacity of stoves that were long enough for the job. In one of his pictures, in which the cores were shown hanging in the rack, one could see the stopping of holes which were provided to allow steam to escape from the inside during drying; those holes were made up afterwards. The cores were turned, and it was remarkable how quickly the moisture was eliminated.

Iron patterns could quite well have been used, but as the bombs had to be machined on the outside, they had not worried very much about the outside. He agreed that chamotte did damage patterns very badly; but it was not used on the outside, for the moulds. The patterns made lasted a long time; it did not matter if they did not match very well, in view of the machining allowance.

MR. DAVENPORT said he had rather gathered from earlier remarks by Mr. Kain that chamotte was used for the outside of the castings.

MR. GRAY replied that an ordinary Yorkshire sand mixture was used there, and not chamotte.

Pouring Technique

MR. C. H. KAIN commented that, although the bomb casting was large and heavy, the ratio of metal thickness to overall dimensions was such that it could almost be called a light casting, from the pouring point of view. He asked for more information concerning the pouring technique, which was not shown clearly in the Paper—how and where the ingate went in, what was the actual speed of pouring, and whether there were difficulties with flow lines or cold shuts on the surface of the bomb.

MR. GRAY replied that the wall thickness of the smaller bomb casting, as cast, was just under 2 in. The pouring speed varied enormously, because they had had to pour eight moulds at times; as the pressure of the ladle dropped, the speed varied considerably, but that did not appear to make much difference to the results. They had poured as fast as they could, using a whirlgate and a slide head at the bottom, which came in tangentially, as shown in Fig. 3. There was a tangential runner. Referring to the down runner and a similar dummy runner on the other side of the pattern, which were used with the help of a close-fitting rod to locate the boxes in closing, he said it was found impossible to make a satisfactory arrangement with the ball and socket device; the substitute had worked very well within the limits required.

There had been very little trouble with tapping because they had poured through a 2½-in. nozzle in the ladle; the quickest time of running achieved was 36 tons in three mins. He had accurate figures available, which he could contribute in writing. There was some wash with the sand, and occasionally there was sand in the metal.

MR. W. H. SALMON welcomed the Paper, which was remarkable in the fact that it was the only one presented to the Conference which dealt with moulding operations.

Referring to Fig. 12, showing the special tackle for tipping the bombs for immersion in oil, he asked if Mr. Gray had experienced any trouble due to entrapped air as they were immersed. Was there any distortion (lack of roundness) of the bomb?

MR. GRAY said he had deliberately chosen the moulding job described as the subject for his Paper, because he felt that the Institute of British Foundrymen could be of great use to the steelfounders, and he wished to encourage the presentation of such moulding problems to that body rather than to the Iron & Steel Institute, which latter was concerned primarily with the metals themselves.

Apparently the Paper was not clear with regard to the method of picking up the bomb in the horizontal position and tipping it to the vertical. There was a ring at the far end of the device which was slid along, and bars to go over the base, and when the bomb was picked up it immediately became vertical. The question of entrapped air did not arise.

(*Continued in col.* 2, *page* 395.)

AMENITIES AT A YORKSHIRE FOUNDRY

Prince-Smith & Stells, Limited, of Keighley, have promoted an advancement in the welfare of foundry workers, whereby up to 200 men can now go to work in "walking out" dress, change into working kit, and at the end of the day's work, have a bath and leave the works decently attired.

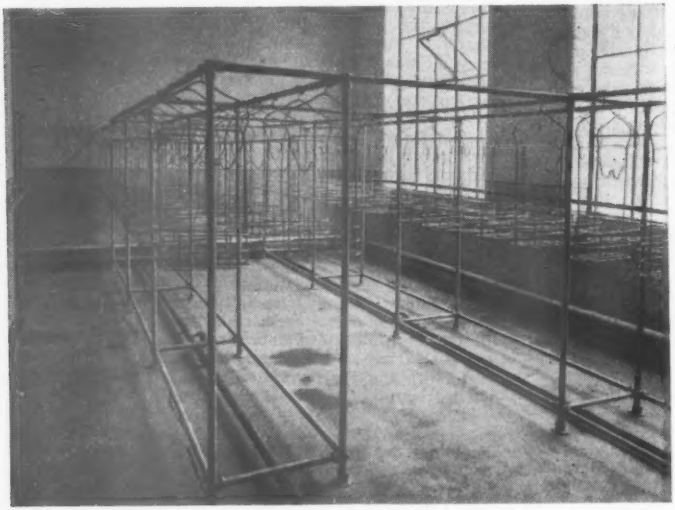


FIG. 1.—CLEAN CLOTHES ROOM.

The men leave their working clothes behind to be thoroughly dried and aired, ready for the following day. Figs. 1 and 2 illustrate the layout and its general appearance.

On arrival at the foundry the men enter the soiled clothes room and are supplied with a numbered clean clothes "grid" (illustrated in Fig. 1) at the observation window. They change into working kit, and hand their outdoor dress on the grid to the attendant, who hangs them in the clean clothes room.

At the end of the day's work they again enter the soiled clothes room, undress, and hang their working kit on a numbered clothes grid. When passing the observation window they are handed a numbered towel, etc., and enter the bathroom, which contains six showers, six wash bowls, and two foot baths. They cleanse themselves of all foundry dirt, leave the bathroom and enter the dressing corridor, where they are handed their clean clothes grid and retire to a dressing cubicle.

The dressing corridor contains three large mirrors, hair dryers, etc., to complete the men's personal appearance, before leaving for home. A check was made on the length of time required to complete transformation, which proved that time would not be lost in waiting, as all employees do not finish work at the same time.

At the opening ceremony, held last month, Mr. D. Waterhouse, chairman and managing director of the company, who initiated the scheme (which is only part of the welfare and social programme, comprising medical and sports facilities, also a fully organised apprentice training scheme), said he hoped the foundry workers would show their appreciation of the new baths by putting them to full use. Mr. L. Featherstone, works manager, also spoke along the same lines.

Mr. F. Thomas, local secretary of the Amalgamated Union of Foundry Workers, declared the new baths open,

(*Continued in column 2, page 402.*)

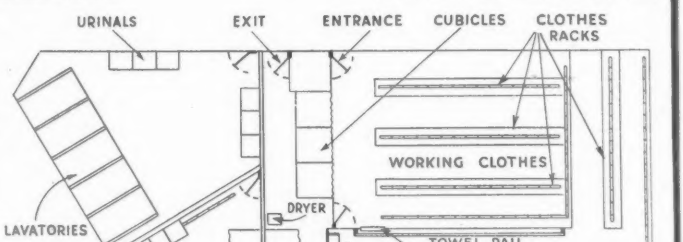


FIG. 2.—PLAN OF NEW WASH ROOM AND LAVATORIES.

ETHYL SILICATE IN THE FOUNDRY*

By PIERRE NICOLAS

Preparation of the Pattern

A start is made by preparing a master-pattern, in bronze for example, of which the dimensions are slightly increased to take into account the contraction. In the case of the alloys of cobalt, chrome and tungsten, this is of the order of 1.5 per cent.; for alloys of the Monel type it is 2 to 2.2 per cent. After that some test castings are cast in order to determine exactly the corrections to be made to the master-pattern. Based on the pattern, a two-part die of soft metal is made, resembling an ordinary core-box. It is made from a tin-bismuth alloy in which the contraction is zero. The so-called die is centred in a steel cage which prevents the deformation of the metal under the pressure arising from the injection of the wax. This wax is of a special composition, and is sometimes modified by hardening agents. The following is a mixture giving a serviceable wax:

Paraffin, 60 per cent.
Carnauba Wax, 25 per cent.
Ceresin, 10 per cent.
Refined Bees Wax, 5 per cent.

The paraffin is of mineral origin, and is a by-product arising from the treatment of heavy oils during the distillation of certain petrols. Carnauba wax is of vegetable origin, coming from a certain type of Brazilian palm tree. As for ceresin, it is obtained by refining a fossil resin, found in petroliferous regions.

The liquid wax, of which the temperature should be kept constant within 3 deg. C., is injected into the die by means of a hand press, at a pressure of 30 kg. per sq. cm. The die is opened and the pattern withdrawn by means of a spike. The die is then washed with soapy water before receiving the next injection. It is very desirable to have the maximum of wax patterns for economic moulding. To do this, a number of patterns are "soldered" as offshoots to a central down runner, also made in wax. In the case of castings difficult to feed, suitable heads are also attached. All these assemblies are made simply by the use of a heated dentist's spatula or by means of soldering wire made of low-resistance metal and moderately heated by an electric current.

Coating the Pattern

So as to obtain the best surface on the finished casting, a coating is put on the wax pattern. In the case of simple castings, it is sometimes done by means of dusting it over with powder. In most cases, this is done by dipping or by pistol spraying of a preparation containing silica flour, details of which will be given later.

Bedding-in the Pattern

The principal agent in the moulding material is a solution of ethyl silicate, which because of its great instability demands certain conditions for its preparation. The initial substance is silicon tetrachloride ($SiCl_4$). This is made by passing chlorine over heated silicon. The silicon tetrachloride is made to react on ethyl alcohol in the proportion of one volume of $SiCl_4$ to 1.3 to 1.5 volumes of 95 per cent. alcohol.

$$SiCl_4 + 4\ C_2H_5\ OH = 4\ HCl + Si\ (OC_2H_5)_4$$

The liberation of hydrochloric acid so obtained is used for the preparation of the pattern coating. A good formula for its preparation is as follows:—8 vols. of ethyl silicate—1 vol. of water; traces of hydrochloric acid in order to set up a partial hydrolysis, and 1 or 2 vols. of ethyl alcohol. The use of ethyl alcohol is rendered necessary in order to create a complete and intimate mixture because the ethyl silicate and the water are not miscible. The whole is treated in a water bath until it reaches a suitable consistency. The material so obtained can be used immediately or stocked for the future.

The moulding material is made up from very fine silica sand, a little magnesia and brick powder, mixed with a bond of an ethyl silicate base, the proportion being about two parts of silica to one of the bond. The work of preparation is done in a mortar mixer. The assembly of the grouped patterns, the runners, risers, and feeders is made in a frame, which often is but a sheet steel cylinder. The moulding material is put in place around the pattern and consolidated by vibration. As the material stiffens rapidly it is necessary to prepare it just prior to use, and generally to co-ordinate the jobs of preparation and of moulding.

The tools must be frequently cleaned in order to prevent the introduction of any hard pieces. The filling and ramming should be carried out beneath a ventilated hood.

Hardening the Mould

An ordinary silica sand mould bonded with ethyl silicate will harden completely in one or two days. This process is accelerated by one of two methods:—(1) By the addition of an accelerator, such as magnesia, the presence of which has already been referred to earlier; (2) by heating to 110 deg. C., which hastens the transformation of the silicic acid to particles of colloidal silica.

In practice, with the mixture used, the hardening is materially advanced, and takes place an hour after vibration, since the rammed moulds are placed runner-face downwards in a stove, of which the temperature is just above that of the melting point of the wax.

The hardening of the mould being completed, the wax is run out and largely reclaimed, only a small proportion having penetrated to a depth of about 20 mm. in the surface of the mould rendered porous by stoving.

Preparation of the Mould for Casting

In order to compensate for the contraction, and to avoid the superheating of the metal cast into the mould, the latter is brought to a high temperature. With this end in view, the mould after removing from the hardening stove, is placed in a furnace of progressively increasing temperature. On entering this furnace, the rest of the wax is burnt out, whilst, before withdrawing, the temperature is of the order of 1,000 deg. C.

* An abridged translation of an article published in the July issue of "Fonderie."

Ethyl Silicate in the Foundry

Melting and Casting

In the case of special alloys, stock material of the correct composition is used. By first melting in the electric furnace, metallic granules, small ingots of well-established composition prepared under controlled conditions are obtained and used as stock. These are also melted in the electric furnace of the indirect arc type. They are quite small, and in actual practice the maximum capacity so far installed is 4½ tons. Furnaces used for the casting of turbo-compress blades are about 2½ tons capacity.

When the metal is melted and brought to a suitable temperature, the furnace tap hole is faced with a layer of asbestos, and clamped thereto is the hot mould coming from the "cooking" stove. The assembly is provided with some balancing "gadgets," and the furnace is tipped to pour the metal into the mould, the introduction being helped by placing the furnace under a low-pressure air system of the order of 0.2 kg. per sq. cm.

Finishing

After an adequate time for cooling—about 4 hours—the casting is stripped; the runners are removed by a wheel, and the castings are shot-blasted, except where sharp edges are incorporated in the design. As normally very delicate castings are made, meticulous inspection is imposed, and it is worth pointing out that resort is had to a penetrating oil (Zyglo), which in a darkened room reveals cracks and other surface defects by a fluorescent effect. Particularly important castings are submitted to X-rays.

Existing Field

During the war, the production of American foundries, specialising in this type of work, was entirely bespoken for the making of turbo-compressor blades. It appears that the output reached the figures of 43 millions. Since the end of hostilities with Japan, American industry has found other outlets. Aside from the high-temperature field, the process has been adapted for uses in which the governing factors are resistance to wear, abrasion, etc., or quite simply, to the making of castings of which the shape makes production by other methods difficult.

The following is a short list of castings which have actually been produced by this method:—Jigs and tools; taps; milling cutters; drills; motor-engine castings; aero engines; wear-resisting castings (sand-blast nozzles), and castings for typewriters, sewing machines, and photographic apparatus.

So far, castings weighing up to 2½ tons have been made, while at the other end of the scale, photographic apparatus components, weighing less than a gramme, have been cast. The process allows of the production of very thin castings, and quite normally the edges of the castings made do not exceed 0.4 mm. ($\frac{2}{1000}$). When a new casting is to be made, it usually refers to a type of problem where the solution depends on the shape of the casting, for the minimum dimension is evidently governed by that of the runner. So far as precision is concerned, it is possible to guarantee a $\frac{1}{1000}$ of an inch for certain castings, but in this connection one is, however, limited by the proportion of admissable scrap. Normally it is possible to accept strict tolerances of this order for one dimension only of the casting, but it is practically never possible to accede to similar conditions for the other dimensions.

Does the new process introduce financial opportunities? From information given out by the large American works and arsenals, and referring to quantities of the order of 1,000 to 4,000 castings, it is gathered that the price of castings made by the lost-wax process is definitely lower than the machined components. From the averaging of published information, it seems that the former are about 59 per cent. of the price of the latter. (This figure is the average of the following values, which correspond to castings of different types made in varying quantities:—34-39-47-58-61-77-95 per cent.) It appears, on the other hand, that the installation of casting shops to carry out the new technique may be cheaper than the creation of an ordinary works for the fabrication by machinery of identical components.

Future Uses

It is reasonably sure that there are other fields for exploitation which so far as is known have not yet been touched, and which are interesting for the making of important castings. The new process could no doubt be applied to the following:—

(1) *Making of castings with an exceptionally clean skin.*—It is easy to envisage a technique similar to that of moulding by exterior core assemblies, and using a pattern which would be coated with a cellulose lacquer insoluble in alcohol. The first layer would be carried carried out in sand bonded with ethyl silicate. The remainder would be in the most economical backing material. The mould would be subjected to a simple stoving and not to a full "cooking."

(2) *Making castings in semi-permanent moulds.*—The study of a suitable moulding material, bonded with ethyl silicate and simply stoving it, could no doubt satisfy the conditions of the pouring of low melting point metals into castings.

AMENITIES IN A YORKSHIRE FOUNDRY

(*Continued from page* 400.)

remarking that they advanced the progress of foundry engineering from the "dead end" occupation it was formerly, to a career with great opportunities. He also suggested that the new baths should not be regarded as an added attraction to new foundry workers, but as an essential part of the plant in foundries everywhere, and that men leaving foundries dead tired, would not feel obliged to walk home, rather than soil the clothes of fellow passengers during 'bus or train journeys.

A vote of thanks to Mr. Thomas was proposed by Mr. H. Sunderland, foundry manager at Strong Close Works, and seconded by Mr. C. Richardson, moulder.

STANTON-DALE
REFINED PIG IRON

Manufactured to guaranteed analyses in seven standard grades. Also obtainable to individual specification

THE 17-TON CASTING ILLUSTRATED IS ONE OF A SERIES MADE IN A STANTON FOUNDRY FROM STANTON DALE IRON

1. Core being lowered into mould
2. Pouring the metal
3. Finished casting in transit

The
STANTON IRONWORKS
COMPANY LIMITED
NEAR NOTTINGHAM

PERSONAL

MR. G. M. SMIBERT has been appointed an additional director of Richardsons Westgarth & Company, Limited.

MR. W. E. EGAR has been appointed a director of Josiah Parkes & Sons, Limited, lock manufacturers, non-ferrous founders, etc., of Willenhall.

MR. A. GOUDIE, of Glasgow, and MR. G. L. JONES, of Cardiff, have joined the technical staff of the International Meehanite Metal Company, Limited.

MR. J. W. SHEPARD and MR. H. D. MAINS have left staff positions with Davidson & Company, Limited, Belfast, to join the board of Musgrave & Company, Limited, Belfast.

MR. G. W. ALLOTT has relinquished his position as general sales manager of the ironworks department of Newton Chambers & Company, Limited, to become assistant to the managing director.

MR. W. T. MARSHALL, at present technical officer to the Institute of Structural Engineers, has been appointed by St. Andrews University Court to the Chair of Engineering and Drawing in University College, Dundee.

MR. N. NICHOLSON has retired from the position of managing director of J. J. Habershon & Sons, Limited, steel rollers and founders, etc., of Rotherham. He will continue as a director. MR. P. J. HABERSHON becomes managing director and continues as chairman of the company. MR. R. P. R. HABERSHON has been appointed assistant managing director along with MR. J. W. HABERSHON. MR. S. R. HAGUE, secretary, becomes a director, and MR. F. S. ALLEN, chief accountant, and MR. W. A. H. DIVER, the company's Birmingham representative, have been made administrative directors.

MR. BRUCE H. LEESON has been appointed Director of the British Electrical and Allied Manufacturers' Association as from October 1, in succession to MR. V. WATLINGTON. Mr. Leeson was intimately connected with the establishment of the first short-circuit testing station in Britain in 1929, and subsequently with the standardisation of switchgear performance which enabled certificates of rating to be issued. He was appointed joint manager of A. Reyrolle & Company, Limited, in 1937, and was elected to the board of directors in the following year. Early in 1940, following his release from military duties, Mr. Leeson became director and general manager. He was appointed managing director of the company last year. He is a director of the Consett Iron Company, Limited, E.R.A. Patents, Limited, and Morphy-Richards, Limited.

Wills

CHARLES, A. A., chairman of the Rother Boiler Company, Limited, and a director of the Rotherham Steel Strip Company, Limited £22,944

SAMUELSON, SIR FRANCIS ARTHUR EDWARD, BT., of Breckenbrough Hall, near Thirsk, Yorks, a former chairman of the Tees Conservancy Commission, president of the Iron and Steel Institute, 1922-1924 £127,018

PAYTON, E. L., of Birmingham, former chairman and joint managing director of Austin Motor Company, Limited, chairman of the Hamstead Colliery (1930), Limited, and a director of a number of companies £1,102,735

GOVERNMENT SALES OF ALUMINIUM

LOSSES ON LIQUIDATION OF STOCKS

The fourth report of the Committee of Public Accounts, published last week as a White Paper, comments on losses sustained on sales of aluminium by the Ministry of Supply. The report states that the selling price of £85 per ton was less than the cost to the Ministry of stocks purchased under earlier arrangements and of that portion of current supplies purchased from British sources. The loss has since been increased, as the controlled selling price was further reduced to £67 per ton in April.

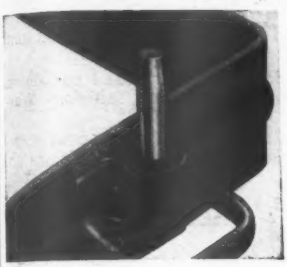
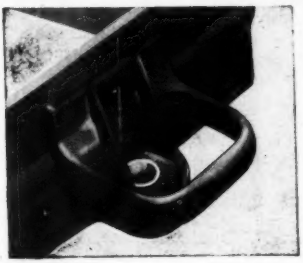
The Ministry explained to the Committee that the war came to an end with very large stocks of aluminium accumulated in this country and the world generally. The price at which new aluminium could be purchased was falling and the Ministry considered it to be more advantageous to proceed with an orderly liquidation of surplus stocks early, rather than to retain them with the probability of making a greater loss later. While the price at which they were selling was not below that at which aluminium was being imported, it was considerably below the price they were paying for home-produced aluminium. In these circumstances the Ministry agreed that the prices being paid to home producers contained an element of subsidy, but stated that the whole position in regard to home producers was under active consideration at the present moment.

The Committee sees no reason to dissent from the Ministry's view that it was necessary to proceed with an early liquidation of surplus stocks. It trusts, however, that before a decision is taken on the general question of home-produced aluminium, the fact that the present arrangements involve a substantial subsidy to home producers will receive the fullest consideration.

EXPORTS OF COPPER, LEAD AND ZINC

The Secretary of the London Metal Exchange has received a letter from the Director of the Non-Ferrous Metals Control referring to a letter dated June 16, 1945, in which, under certain conditions, copper, lead and zinc could be exported in lots not exceeding 10 tons. The contents of this letter have been withdrawn and the present position is as follows:—Copper: no tonnages are available for export from the U.K., except in very special circumstances. Lead and zinc: no tonnages are available for export from the U.K., apart from when, from time to time, small tonnages of lead and zinc are made available in this country by overseas producers to enable small lots to be shipped for their account from the U.K., instead of from the producing countries.

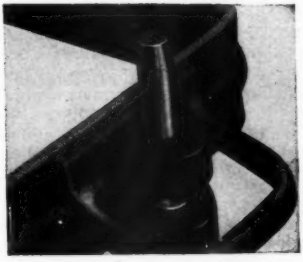
MEMBERSHIP OF THE American Foundrymen's Association has been doubled since the war, and now stands at 8,539, representing a gain during the year of 727 members. It now operates 32 chapters or branches.

Some special features of "TALBARD" Moulding Boxes

NOTE THESE FACTS—

- Special corrugated, concave section, giving lightness with utmost strength and rigidity.
- Excellent sand retention.
- Comfortable malleable iron handles.
- Precision ground pins adjustable for length.
- Ease in fitting with minimum pin clearance.
- Ground box faces.
- Accurate pin centres and guaranteed interchangeability.
- Renewable mild steel bushes.
- Optional hardened steel bushes, round or elongated.



- Wide range of sizes and types for steel, iron or non-ferrous work.
- Range of fittings, bars, straight handles, clamps, etc. as required.
- Particular attention to export requirements, expert packing, lowest c.i.f. prices.

E. TALLIS & SONS LTD.

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BIRMINGHAM, 12

Phone: MIDland 4387
'Grams: "Talbard"

NEWS IN BRIEF

THE LONDON QUOTATION for refined platinum is now £20 per troy ounce, against £17 previously.

THE COMPANIES REGISTRATION OFFICE announces that the name of the Wembley Aluminium, Limited, has been struck off the register and the company is dissolved.

WATSONS (METALLURGISTS), LIMITED, of Dronfield, Yorks, announce that, having introduced a five-day week, their works and offices will in future be closed on Saturdays.

THE 1946 EDITION of the directory of members, subscribers and representatives of the Birmingham Exchange has just been published. Mr. A. Dudley Evans, secretary, contributes an interesting article on the origin and development of the Exchange.

IN ORDER TO counter pressure now being exerted on unions in the foundry industry to accept the Ministry of Labour's proposal that Italian workers should be brought into the industry, the unions have agreed to an up-grading of workers. Unskilled labour will be admitted to simple machine moulding and experienced machine moulders to loose pattern moulding.

THE U.S. STEEL CORPORATION report a profit for the June quarter of $ 13,900,270, against $ 16,774,202 in the corresponding quarter of last year. This is equal to 87 cents ($ 1.27) per share. The profit was made possible by charging the cost of the coal strikes in April and May, amounting to $ 11,266,791, to the specified post-war reserve, and absorbing a credit of $ 500,000.

THE TEXT OF the amended Fair Wages Clauses to be inserted in Government contracts, which the House of Commons will be asked to approve by resolution after the summer recess, has been tabled by the Minister of Labour in the House. The new Fair Wages Resolution will take the place of the resolution passed by the House in 1909, and the terms are the outcome of an agreement reached in 1942 after discussions between the British Employers' Confederation, the Trades Union Congress, and the Government.

NEW MINIATURE LAMPHOUSE

The range of the photo-electric accessory equipment of the General Electric Company, Limited, has been augmented by a new miniature lamphouse known as type M.L.H. This has been produced to meet the demand for a compact light source suitable for industrial applications where the distance to be spanned does not exceed 3 ft., and where the existing types of G.E.C. lamphouse cannot be used because they are either too large or are optically unsuitable.

The lamphouse is designed for use in conjunction with the G.E.C. photocell relay amplifier. An Osram double contact, 12-volt, 6-watt automobile lamp is used as the light source. To ensure adequate life this should be operated from the 10-volt winding provided on the amplifier transformer. Telescopic adjustment of the lens enables the light beam to be focussed accurately. This ensures that a sharp image is produced so that sufficient light can be passed through a slit about 2 mm. wide at the amplifier end.

NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"ALUWARE"—Metal hollow-ware. LEWIS GELLMAN, 34, Norfolk Street, Strand, London, W.C.2.

"WARCO"—Metal domestic utensils and containers. WARWICK AVIATION COMPANY, LIMITED, Saltisford, Warwick.

"WELDCON"—Welding machines. WELDING CONTROLS, LIMITED, 1A and 24, High Street, Kempston, Beds.

"ROTILIFT"—Lifting apparatus. R. S. MCHUGH & COMPANY, LIMITED, 46, Sandhill, Newcastle-upon-Tyne, 1.

"AVA"—Earth-working machines, endless conveyors, etc. T. RODDIS, LIMITED, 75, Overston Road, Northampton.

"SPRINGBOK"—Metal fittings and fastenings. JAMES B. MILNER, Stanway, Bryn Newydd West, Prestatyn, Flintshire.

"MICRODOL"—Pulverised dolomite. AKSJESELSKAP NORWEGIAN TALC, c/o A. J. Davies, 24, Moorfields, Liverpool, 2.

"ZIP"—Electrically heated hot-water storage apparatus. HEATRAE, LIMITED, Heatrae Works, St. Georges Street, Norwich.

"FOSECO"—Air compressors, crushing machines, foundry moulding machines, metal-working machines, rolling mills, etc. FOUNDRY SERVICES, LIMITED, 285, Long Acre, Nechells, Birmingham, 7.

EXPORTS OF COPPER, LEAD AND ZINC

The Secretary of the London Metal Exchange has received a letter from the Director of the Non-Ferrous Metals Control referring to a letter dated June 16, 1945, in which, under certain conditions, copper, lead and zinc could be exported in lots not exceeding 10 tons. The contents of this letter have been withdrawn and the present position is as follows:—Copper: no tonnages are available for export from the U.K., except in very special circumstances. Lead and zinc: no tonnages are available for export from the U.K., apart from when, from time to time, small tonnages of lead and zinc are made available in thiscountry by overseas producers to enable small lots to be shipped for their account from the U.K., instead of from the producing countries.

THE LATE SIR ALLAN MACDIARMID

A booklet containing appreciations of Sir Allan Campbell Macdiarmid, late chairman of Stewarts and Lloyds, Limited, has been prepared by Mr. A. G. Stewart, the present chairman, and circulated privately among Sir Allan's relatives and friends. A gracious tribute to a great man, it contains the address given at the memorial service on August 22, 1945, by the Bishop of Sheffield and appreciations published in "The Times," the "Glasgow Herald," and other journals.

WORKINGTON CYLINDER IRONS

THE UNITED STEEL COMPANIES LTD

Workington "UCO" All-Mine Cylinder Irons are manufactured direct from West Coast hematite irons of high purity and uniform composition, without the addition of scrap and without remelting. Available in a range of analyses; with low carbon and silicon content, machine cast, they melt rapidly and cleanly, imparting dense structure and wear resistance with uniform soundness to the castings.

WORKINGTON IRON & STEEL COMPANY

WORKINGTON Telephone: Workington 206 Telegrams: "Mosbay," Workington CUMBERLAND

Branch of The United Steel Companies Limited

W. 77

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Clearface Foundry, 41-42, Saffron Hill, London, E.C.1—£500.

D.H. Metal Products, 10, Ashley Place, London, S.W.1—£500. S. H. Barnes.

Pressmatic—Engineers, etc. £1,000. C. E. Surman, 3, The Fairway, New Barnet, subscriber.

Leyroy Engineering Company, Rendle Street, Plymouth—£3,000. H. Riley and R. F. Williams.

Central Metal Works, 16, Feeders Road, St. Philips, Bristol, 2—£5,000. H. H. Stoodley and A. Stych.

Refrigeration Engineering, 22a, Barwick Street, Scarborough—£2,000. E. Good, J. R. Dewerth, and E. W. Robson.

Perham Engineering Company, 6, Earl's Court, Road, London, S.W.5—£1,500. A. J. Shields and G. A. Stevens.

Armac Engineering Company, 14, Hospital Street, Glasgow—£2,000. S. Gerber, L. S. Sellyn, and L. Hirsfield.

Ernest F. Sharpe (Walsall)—Metal goods manufacturers—£2,500. E. F., E. B. and J. Sharpe, 20, Boscobel Road, Walsall.

Robert Murdoch & Company (Iron), 23, Robertson Street, Glasgow—£20,000. J. Murdoch, D. C. Sinclair and A. Davidson.

Victor Engineering (Manchester), Byrom Street, Quay Street, Manchester, 3—£5,000. W. H. Wheeldon, G. H. Naylor, and L. C. Ogden.

Tibbits & Allen, 238, Cherry Hinton Road, Cambridge—Engineers, etc. £4,000. J. G. Tibbitts, R. G. Duce, A. A. and B. D. Harriss.

W. C. Hercus & Company, Station Approach, Cuffley, Herts—Engineers, etc. £2,000. W. C. Hercus, A. H. Hucks, A. J. and H. L. Gilbey.

A. N. Wilkinson, Derwent Foundry, Whatstandwell, Derbyshire—Brassfounders. £2,500. A. W. Wragg, A. Hawksley, and A. N. Wilkinson.

H. W. Mackie (London), 118, Chancery Lane, London, W.C.2—Engineers, etc. £1,000. H. W. Mackie, E. G. Farah, and S. T. Rhodes.

P. E. Sinden (Components), 117, Churchfield Road, West Acton, London, W.3—Manufacturers of machinery, etc. £1,000. P. E. Sinden, J. E. and J. E. Bufton.

Cartwright & Grealey Bros., 34, Pearson Street, Brierley Hill, Staffs.—Engineers, etc. £1,000. A. E. Cartwright, G. H. and M. Grealey, and H. C. Clarke.

Smithson & Burroughes—Agricultural and general engineers. £5,000. F. G. Smithson and S. W. Burroughes, Rockland Manor, Attleborough, Norfolk.

Grove Press Company, 5, Cattells Grove, Nechells, Birmingham—Ironfounders, engineers, etc. £1,000. S. J. W. Henwood, J. E. Margetts, J. Scriven, and H. J. Allen.

West Cumberland Structural Engineering Company, 27, Jane Street, Workington—£500. W. G. Kettell, W. H. Corrie, J. S. McCanch, J. J. Cannon, and W. S. Barnes.

Lovick Johnson Company, 125-7, Balham High Road, London, S.W.12—Manufacturers of boilers and boiler-plant equipment, etc. £5,000. F. S. Lovick Johnson.

Bettin Metal Works, 4-10, Dolland Street, Kennington, London, S.E.11—General engineers and machinists. £1,500. J. M. Ballantyne, S. D. Sparks, and E. M. Eastcott.

Brett, White & Company, 72, Chalk Farm Road, St. Pancras, London, N.W.1—Metal workers, engineers, etc. £2,000. H. S. White, A. J. Brett, G. Carter, and M. Kraft.

CONTRACTS OPEN

Any date given is the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

Bideford, August 21—Supply, laying and jointing of approx. 930 yds. of 4-in. dia. cast-iron water main, for the Town Council. The Borough Surveyor, Town Hall, Bideford. (Fee £2 2s., returnable.)

Cambridge, August 24—Cast-iron kerb outlets, for the County Council Roads and Bridges Department. The Clerk, Shirehall, Cambridge.

Glastonbury, August 26—Construction of approx. 500 yds. of 3-in. cast-iron water main, etc., for the Borough Council. Mr. H. N. Alves, architect, 66, High Street, Glastonbury. (Fee £2 2s., returnable.)

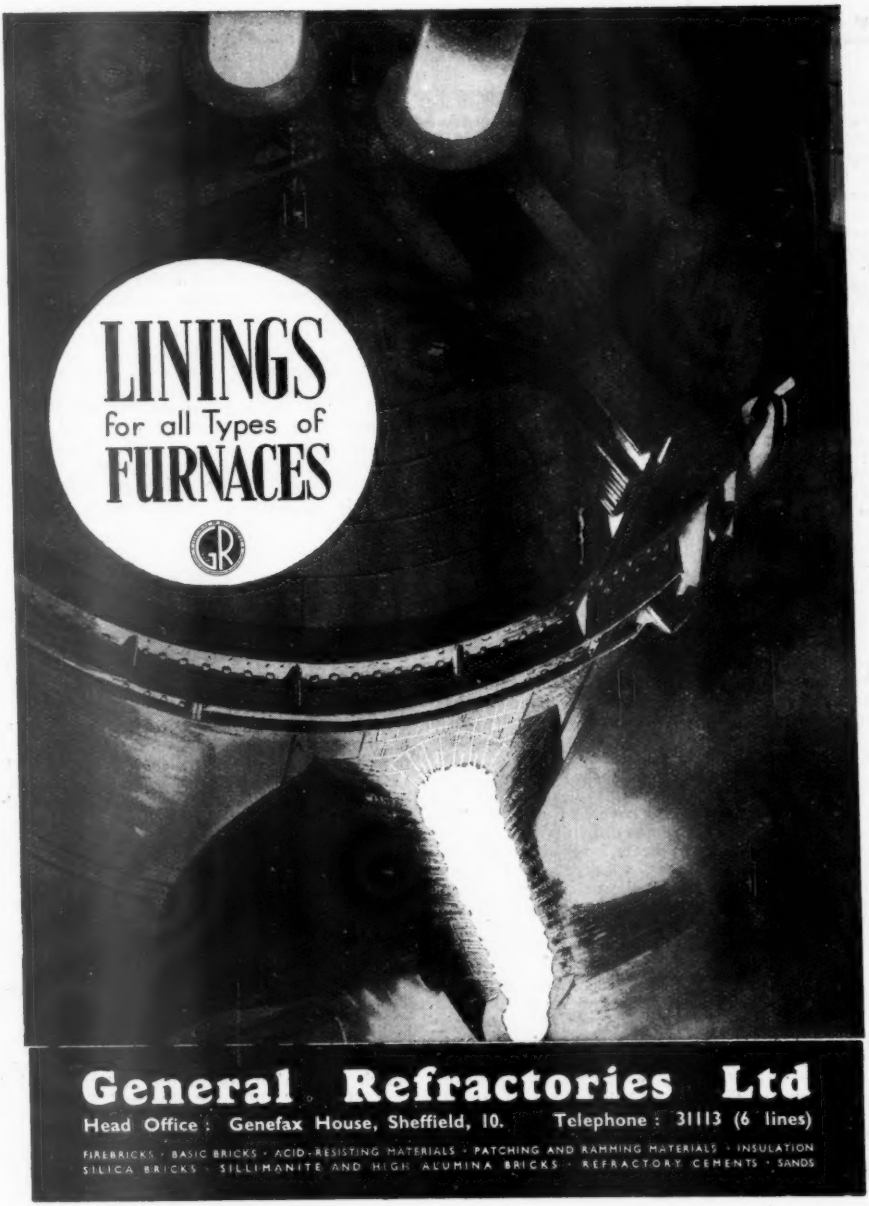
Godalming, August 31—Supplying and laying spun-iron water main and specials, for the Water Department. Mr. C. B. Spivey, water engineer, 35, Bridge Street, Godalming. (Fee £2 2s., returnable.)

Llangefni, August 22—12,500 yds. of 4-in. dia.. and 600 yds. of 3-in. dia. cast-iron (spun) pipes, or alternatively, the same quantity of asbestos cement pressure pipes, together with about 10 tons of special castings, for the Anglesey County Council. Rofe & Raffety, engineers, 3, Victoria Street, Westminster, London, S.W.1. (Fee £1 1s., returnable.)

Rhyl, August 28—Supply and erection of a cast-iron purifier 16 ft. by 28 ft. by 5 ft., together with the necessary valve and connections, for the Urban District Council. Mr. O. P. Cronshaw, engineer and manager, Gas Offices, Paradise Street, Rhyl.

Salisbury, September 21—Iron castings, fittings and plant, etc., for 12 months from October 1, for the City Council. Mr. S. R. Little, city engineer, Council House, Bourne Hill, Salisbury.

Sunderland, August 20—Steel wire reinforcement for concrete, cast-iron rainwater goods and sanitary fittings, gullies, manhole covers, step irons, etc., for six months from October 1, for the Corporation. The Borough Engineer, Town Hall, Fawcett Street, Sunderland.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Raw Material Markets

IRON AND STEEL

NEWS OF INCREASES in the maximum prices of the main qualities of pig-iron by from 4s. 6d. to 6s. 6d. a ton and of heavy steel by 5s. a ton, as from yesterday (Wednesday), was received as we went to press. The higher rates have been necessitated by increases in railway rates, coke prices, wages, and other costs. Prices of more finished products have been, where necessary, increased by amounts which reflect the effect of the increases in pig-iron and semi-finished steel as well as the increase in direct processing and delivery costs. Wrought iron in any form and cemented carbide hard metal tool tips are freed from control.

Staggered holidays continue to interfere with outputs at the foundries. Pressure for light castings is unabated, and foundries have many months' work already booked, while there is undoubtedly still a lot of business to be placed. The current output of high-phosphorus pig-iron is keeping pace with immediate requirements, but stocks are low both at the foundries and at the furnaces. Unless present allocations can be improved upon the implementation of reserves will be out of the question.

The general engineering, speciality and jobbing foundries are well employed, and the demand for hematite, low- and medium-phosphorus and refined irons is substantial. These foundries use considerable quantities of steel and cast-iron scrap, and supplies are reasonably good, but there continues to be a shortage of light and medium scrap for the light foundries. The engineering foundries also use ferro-alloys, such as ferro-silicon and ferro-manganese, supplies of which are adequate. Reasonably good supplies of limestone and ganister are available. Considerable headway has been made in the last few weeks on the foundry coke allocation scheme, and many consumers have had their supplies cut down.

The sheet makers have as much work already on hand as they can accomplish this year, while the makers of light sections are also covered for six months and users are having extreme difficulty in getting additional light angles and sheets booked except for Periods 1 and 2 of next year. Large quantities of steel billets are necessary to get the maximum outputs, and the demands are taxing the resources of the Control. The heavy-steel makers are fully employed. their order-books extending for several months ahead.

NON-FERROUS METALS

It is reported that the American Metals Reserve Company, the Government buying agency, is having to pay a higher price for supplies of Chilean copper in the third quarter of the year and that the quantity of metal available to the United States during that period will be substantially less than was procured in the second quarter. At a time when domestic production is suffering from the effects of strikes which have closed mines and refineries for a long period, the news of reduced Chilean supplies has been particularly disappointing to American consumers. During the past few months a number of European countries, including Great Britain and France, have negotiated for supplies of copper from Chilean producers.

Consumption of virgin copper in the United Kingdom, according to the British Non-Ferrous Metals Federation, amounted to 23,690 tons in June, against 30,030 tons in May, while consumption of scrap rose to 15,890 tons, compared with 13,590 tons. With the exception of strip and sheet production, all forms of fabrication contributed to the lower total consumption.

It is reported from New York that the Metals Reserve Corporation has issued a new contract authorising the Tin Sales Corporation—an agent of the Reconstruction Finance Corporation—to sell the August allotment of tin at the O.P.A. figure on the date of shipment, or in the absence of any controls at the price quoted in American metal markets. This announcement is construed in some quarters as indicating early decontrol of tin. By the contract the Tin Sales Corporation is permitted to sell tin at the current ceiling price of 52 cents per lb., and if the price should be raised by the O.P.A., or if the Price Decontrol Board eliminates price ceilings, at the price prevailing in the open market.

OBITUARY

MR. S. V. WILLIAMS, B.Sc., head of the metallurgical section of the General Electric Company's research laboratory at North Wembley, died recently. A graduate of the University of Wales, where he studied under Dr. Edwards, Williams spent practically the whole of his career in metallurgical research work. In recent times he devoted much attention to a study of the gaseous annealing of malleable cast iron, and in conjunction with his colleagues, presented the results to the Institute of British Foundrymen in a series of Papers. Mr. Williams was a prominent member of the Institute of Metals, and was chairman-elect of the London section. His sudden death has cut short a promising career at a comparatively early age.

Charles Churchill & Company—Income for the year ended March 31, £105,260 (£119,814); tax, £54,215 (£64,642); net profit, £49,745 (£53,872); to reserve, £30,000 (£35,000); final dividend of 25% (same), making 35% (same), and bonus of 12½% (nil); forward, £30,122 (£33,196).

Metal Box Company—Profit for the year ended March 31, after debenture interest and taxation, £264,210 (£242,428); net dividend from a subsidiary (now liquidated and consolidated), £11,441 (£1,352); final dividend of 12½%, making 17½% (same), plus special dividend of 2½% (nil); forward, £193,628 (£195,747).